

ASANO et al., Appl. No. 09/889,920
AF Amdt. dated 4 April 2005
Reply to final OA dated 3 January 2005

520.40381X00/NT0397US
Page 2

IN THE CLAIMS:

1.-22. (Canceled):

23. (Currently Amended) The deficiency inspection method according to claim 22, wherein the deficiency candidate on the surface of said specimen is detected by using information of luminance of said green (G) signal component of said image.

24. and 25. (Canceled)

26. (Currently Amended) A deficiency inspection method based on a penetrant inspection scheme, comprising the steps of:

picking up an image of a surface of a specimen by using a color camera;

converting RGB data of the picked-up image to chromaticity and luminance, and computing hue and chrominance in each position on the picked-up image from said chromaticity and luminance; and

detecting a deficiency candidate on said surface by using information of said hue and chrominance computed from said chromaticity and luminance converted from said RGB data of the picked-up image.

27.-29. (Canceled)

ASANO et al., Appl. No. 09/889,920
AF Amdt. dated 4 April 2005
Reply to final OA dated 3 January 2005

520.40381X00/NT0397US
Page 3

30. (Currently Amended) The deficiency inspection method according to ~~any one of claims 22-27~~ claim 26, wherein said image of said surface is picked up by said color camera over plural visual fields.

31.-33. (Canceled)

34. (Currently Amended) The deficiency inspection apparatus according to ~~claim 33~~ 47, wherein said illumination means has an ultraviolet-rays illuminating section for illuminating said ultraviolet rays onto said surface of said specimen, and a white-light illuminating section for illuminating white light onto said surface of said specimen.

35. (Previously Presented) A deficiency inspection apparatus, comprising:
illumination means for illuminating a surface of a specimen;

image pickup means for picking up an image of said surface by using a color camera through a filter, which is calibrated by using a camera calibration color chart for inspection;

magnetic-particle-inspection-originated deficiency-candidate extraction means for extracting magnetic-particle-inspection originated deficiency candidates in said surface from said image of said surface picked up by said image pickup means;

penetrant-inspection-originated deficiency-candidate extraction means for extracting penetrant-inspection-originated deficiency candidates in said surface from said image of said surface picked up by said image pickup means; and

ASANO et al., Appl. No. 09/889,920
AF Amdt. dated 4 April 2005
Reply to final OA dated 3 January 2005

520.40381X00/NT0397US
Page 4

display means for displaying images of said deficiency candidates detected by said magnetic-particle-inspection-originated deficiency-candidate extraction means or said penetrant-inspection-originated deficiency-candidate extraction means,

wherein said magnetic-particle-inspection originated deficiency candidates in said surface from said image of said surface picked up by said image pickup means are obtained by using a green (G) signal component of said image which contains the largest amount of emission information of fluorescent magnetic powder applied on said surface and irradiated by ultraviolet rays filtered through said filter; and

wherein said penetrant-inspection-originated deficiency candidates in said surface from said image of said surface picked up by said image pickup means are obtained by converting image data of said image of said surface to chromaticity and luminance and computing hue and chrominance in each position on said image from said chromaticity and luminance.

36. and 37. (Canceled)

38. (Previously Presented) A deficiency inspection apparatus based on a probing scheme, comprising:

illuminating means for illuminating light on a surface of a specimen to which a penetrant inspection treatment is applied;

image pickup means for picking up an image of said surface illuminated with said light by a color camera, which is calibrated by using camera calibration color chart for inspection;

ASANO et al., Appl. No. 09/889,920
AF Amdt. dated 4 April 2005
Reply to final OA dated 3 January 2005

520.40381X00/NT0397US
Page 5

converter means for converting RGB data of said image picked-up by said image pickup means to chromaticity and luminance, and computing hue and chrominance in each position on said image picked-up from said chromaticity and luminance;

deficiency-candidate detecting means for detecting deficiency candidates by using information of said hue and chrominance computed from said chromaticity and luminance of said image picked-up; and

display means for displaying images of said deficiency candidates detected by said deficiency-candidate detecting means.

39. (Previously Presented) A deficiency inspection apparatus, comprising:

illuminating means for illuminating light on a surface of a specimen to which a penetrant-inspection treatment is applied;

image pickup means for picking up an image of said surface illuminated by said illuminating means by a color camera calibrated using a camera calibration color chart for inspection;

converter means for converting RGB data of said image picked-up by said image pickup means to chromaticity and luminance, and computing hue and chrominance in each position on said image picked-up from said chromaticity and luminance;

deficiency-candidate detecting means for detecting deficiency candidates on said surface from said image picked-up by using information of said hue and

ASANO et al., Appl. No. 09/889,920
AF Amdt. dated 4 April 2005
Reply to final OA dated 3 January 2005

520.40381X00/NT0397US
Page 6

chrominance computed from said chromaticity and luminance converted from said RGB data;

display means for displaying images of said deficiency candidates detected by said deficiency-candidate detecting means; and

memory means for storing displayed images with data of chromaticity and luminance obtained by said converter means.

40. (Previously Presented) A deficiency inspection apparatus, comprising:

illumination means for illuminating a surface of a specimen;

image pickup means for picking up an image of said surface by using a color camera through a filter which is calibrated by using a camera calibration color chart for inspection camera;

magnetic-particle-inspection-originated deficiency-candidate detecting means for detecting magnetic-particle-inspection originated deficiency candidates on said surface from a green (G) signal component of said image of said surface picked up by said image pickup means which contains the largest amount of emission information of fluorescent magnetic powder applied on said surface and irradiated by ultraviolet rays filtered through said filter;

penetrant-inspection-originated deficiency-candidate detecting means for converting image data of said image of said surface to chromaticity and luminance, computing hue and chrominance in each position on said image from said chromaticity and luminance, and detecting penetrant-inspection-originated deficiency candidates on said surface from said image picked up by said image pickup means

ASANO et al., Appl. No. 09/889,920
AF Amdt. dated 4 April 2005
Reply to final OA dated 3 January 2005

520.40381X00/NT0397US
Page 7

by using information of said hue and chrominance computed from said chromaticity and luminance; and

display means for displaying images of said deficiency candidates detected by said magnetic-particle-inspection-originated deficiency-candidate detecting means, or said penetrant-inspection-originated deficiency-candidate detecting means.

41. (Currently Amended) The deficiency inspection apparatus according to ~~any one of claims 33 to 40~~, further claim 35, comprising positional information display means arranged in a visual field of said color camera, for displaying positional information of said visual field of said color camera.

42. (Previously Presented) The deficiency inspection apparatus according to claim 40, wherein said positional information display means is a scale.

43. (New) A deficiency inspection method based on a magnetic-particle inspection scheme, comprising:

irradiating an ultraviolet light on a surface of a specimen on which a magnetic particle is coated;

picking up an image on a surface of a specimen by using a color camera through a filter which filters the ultraviolet light among light from the surface of said specimen including a fluorescent light emitted from the magnetic particle coated on said specimen and irradiated by the ultraviolet light;

ASANO et al., Appl. No. 09/889,920
AF Amdt. dated 4 April 2005
Reply to final OA dated 3 January 2005

520.40381X00/NT0397US
Page 8

detecting a deficiency candidate on the surface of said specimen by using a green (G) signal component of said image which contains the largest amount of emission information of the fluorescent light, acquired by said color camera;
displaying an image of said detected deficiency candidate on a screen;
and storing the displayed image in a memory,
wherein said image of said surface is picked up by said color camera over plural visual fields.

44. (New) A deficiency inspection method based on a magnetic-particle inspection scheme, comprising:

irradiating ultraviolet rays on a surface of a specimen to which a solution containing fluorescent magnetic powder is applied;

picking up an image of the surface of said specimen irradiated with said ultraviolet rays by a color camera through a filter which filters said ultraviolet rays among light from the surface of said specimen including a fluorescent light emitted from a magnetic particle applied on the surface of said specimen and irradiated by said ultraviolet rays; and

displaying an image acquired by said color camera on a screen, by using a green (G) signal component of said image which contains the largest amount of emission information of said fluorescent magnetic powder irradiated by said ultraviolet rays, in nearly the same state as an image acquired by visually observing said surface irradiated with said ultraviolet rays,

ASANO et al., Appl. No. 09/889,920
AF Amdt. dated 4 April 2005
Reply to final OA dated 3 January 2005

520.40381X00/NT0397US
Page 9

wherein said image of said surface is picked up by said color camera over plural visual fields.

45. (New) A deficiency inspection method based on a magnetic-particle inspection scheme, comprising:

irradiating ultraviolet rays on a surface of a specimen to which a solution containing fluorescent magnetic powder is applied;

picking up an image of the surface of said specimen irradiated with said ultraviolet rays by a color camera via an ultraviolet-rays filter which filters said ultraviolet rays among light from the surface of said specimen including a fluorescent light emitted from a magnetic particle applied on the surface of said specimen and irradiated by said ultraviolet rays;

extracting deficiency candidates from an image acquired by said color camera, by using a green (G) signal component of said image which contains the largest amount of emission information of said fluorescent magnetic powder irradiated by said ultraviolet rays; and

displaying on a screen images of the extracted deficiency candidates,
wherein said image of said surface is picked up by said color camera over plural visual fields.

46. (New) A deficiency inspection method based on a penetrant-inspection scheme, comprising:

illuminating a surface of a specimen with polarized light;

ASANO et al., Appl. No. 09/889,920
AF Amdt. dated 4 April 2005
Reply to final OA dated 3 January 2005

520.40381X00/NT0397US
Page 10

picking up an image of said surface illuminated with said polarized light by a color camera via a polarization filter, wherein said color camera is calibrated by using a camera calibration color chart for inspection;

extracting deficiency candidates from said image acquired by said color camera; and

displaying images of said extracted deficiency candidates on a screen,
wherein in the step of extracting deficiency candidates, said image is calibrated using a calibration parameter inherent to said color camera determined from image data of said camera calibration color chart picked up by said color camera, and

wherein said image of said surface is picked up by said color camera over plural visual fields.

47. (New) A deficiency inspection apparatus for magnetic-particle-inspection, comprising:

illumination means for illuminating a surface of a specimen on which a magnetic particle is coated;

image pickup means for picking up an image on the surface of said specimen by a color camera through a filter which filters ultraviolet rays amount light from the surface of said specimen including a fluorescent light emitted from the magnetic particle coated on said specimen and irradiated by said ultraviolet rays;

deficiency-candidate detecting means for detecting deficiency candidates on the surface of said specimen by using a green (G) signal component of said image

ASANO et al., Appl. No. 09/889,920
AF Amdt. dated 4 April 2005
Reply to final OA dated 3 January 2005

520.40381X00/NT0397US
Page 11

which contains the largest amount of emission information of said fluorescent light,
picked up by said image pickup means;

display means for displaying images of said deficiency candidates detected by
said deficiency-candidate detecting means; and

positional information display means arranged in a visual field of said color
camera, for displaying positional information of said visual field of said color camera.

48. (New) A deficiency inspection apparatus for magnetic-particle-inspection,
comprising:

an illuminator which illuminates a surface of a specimen on which a magnetic
particle is coated;

a camera which picks up an image on said surface, via a filter, which filters an
ultraviolet light among light from the surface of said specimen including a fluorescent
light emitted from the magnetic particle coated on said specimen and irradiated by
said ultraviolet light;

a deficiency-candidate detector which detects deficiency candidates on said
surface of said specimen from said image on said surface picked up by said camera
by using a green (G) signal component of said image which contains the largest
amount of emission information of said fluorescent light;

a storage section which stores images of said deficiency candidates detected
by said deficiency-candidate detector;

a display unit which displays information of said images of said deficiency
candidates stored in said storage section on a screen; and

ASANO et al., Appl. No. 09/889,920
AF Amdt. dated 4 April 2005
Reply to final OA dated 3 January 2005

520.40381X00/NT0397US
Page 12

positional information display means arranged in a visual field of said color camera, for displaying positional information of said visual field of said color camera.

49. (New) A deficiency inspection apparatus, comprising:

ultraviolet-rays irradiation means for irradiating ultraviolet rays onto a surface of a specimen to which a solution containing fluorescent magnetic powder is applied;

image pickup means for picking up an image of said surface irradiated with said ultraviolet rays by a color camera through a filter which filters said ultraviolet rays among light from the surface of said specimen including a fluorescent light emitted from a magnetic particle applied on the surface of said specimen and irradiated by said ultraviolet rays;

display means for displaying said image of said surface picked up by said image pickup means on a screen, by using a green (G) signal component of said image which contains the largest amount of emission information of said fluorescent magnetic powder irradiated by said ultraviolet rays, in nearly the same state as an image acquired by said visual observation; and

positional information display means arranged in a visual field of said color camera, for displaying positional information of said visual field of said color camera.